$$R_2 = R_0 - L_1 R_1 R_2 + L_2 R_1 R_2 PAN$$

$$R_2 = \frac{R_0}{1 + L_1 R_1 + L_2 R_1 PAN}$$

$$R_3 = R_2 - k_4 R_3$$

$$R_3 = \frac{R_2}{1 + k_4}$$

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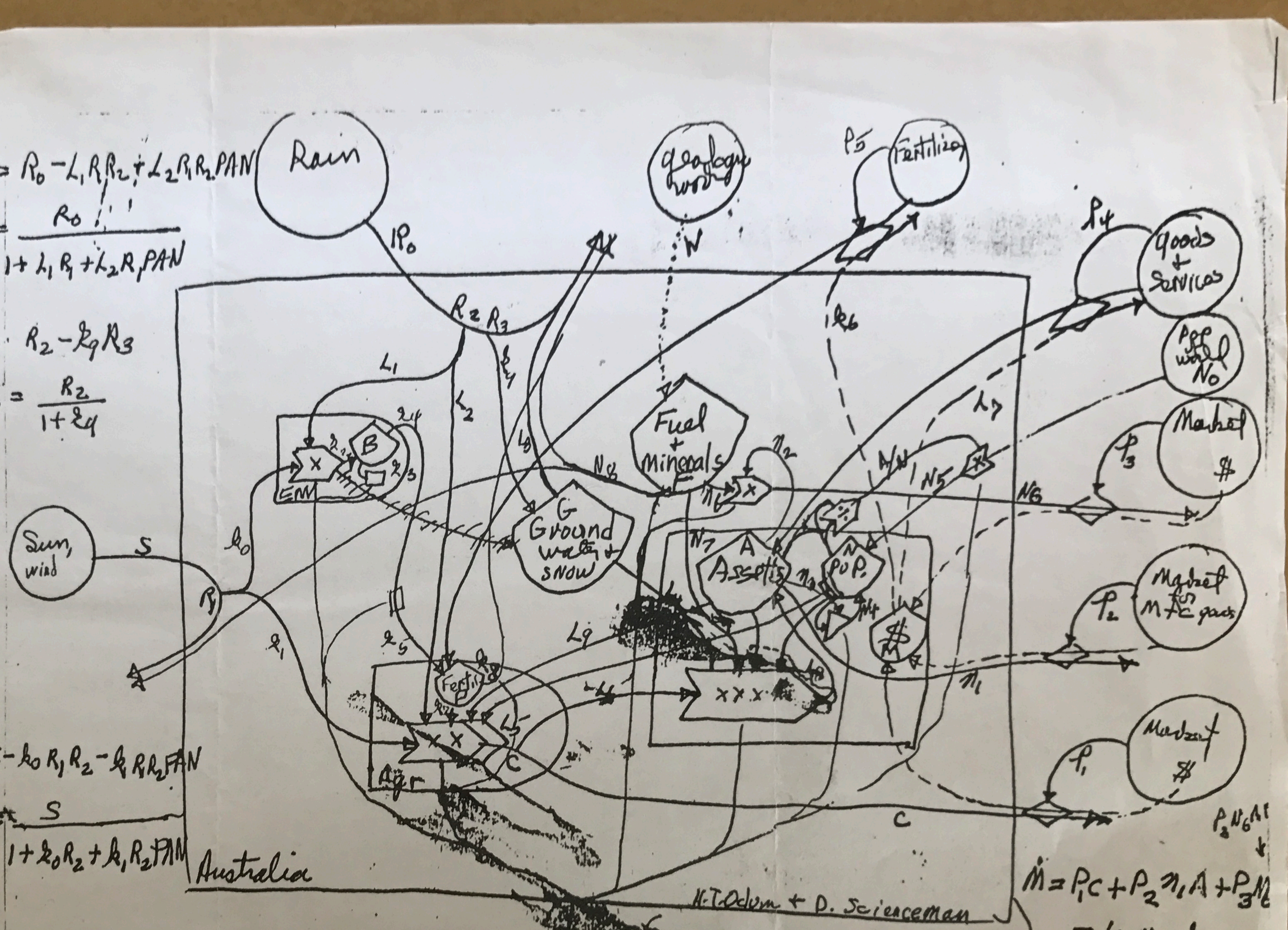


$$R_1 = S - k_0 R_1 R_2 - k_1 R_1 R_2 PAN$$

$$R_1 = \frac{S}{1 + k_0 R_2 + k_1 R_2 PAN}$$

$$\dot{M} = P_1 C + P_2 n_1 A + P_3 M_c - L_7 M - k_6 M$$

$$\dot{B} = k_2 R_1 R_2 - k_3 B - r_4 B$$

$$\dot{P} = k_6 B + \frac{k_5 M}{P_5} - k_7 R_1 R_2 PAN - k_8 P$$

$$\dot{G} = k_4 R_3 - L_3 G - L_4 C GFAN$$

$$\dot{C} = L_5 R_1 R_2 PAN - L_6 C GFAN$$

$$C = \frac{L_5 R_1 R_2 PAN}{1 + L_6 GFAN}$$

$$\dot{A} = \frac{L_7 M}{P_4} + L_8 CGFAN - L_9 R_1 R_2 PAN - n_1 A - n_2 AF - n_3 N$$

$$\dot{N} = N_4 N + N_5 (AN)(N_0) \qquad \dot{F} = W - N_6 AF - N_7 CGFAN - N_8 P$$

<u>EQUATIONS FOR THE SIMULATION OF THE ENERGY DIAGRAM OF AUSTRALIA</u>

PREPARED BY PROFESSOR H.T. ODUM. 1993

TYPED BY DR. DAVID M. SCIENCEMAN, 09 DECEMBER 2006.

$$\dot{B} = k_2R_1R_2 - k_3B - k_4B$$

$$\dot{P} = k_5B + \frac{k_6M}{p_5} - k_7R_1R_2PAN - k_8P$$

$$\dot{G} = k_9R_3 - L_8G - L_4CGFAN$$

$$\dot{A} = \frac{L_7M}{p_4} + L_8CGFAN - L_9R_1R_2PAN - n_1A - n_2AF - n_3N$$

$$\dot{N} = N_4N + N_5N_o\left(\frac{A}{N}\right)$$

$$\dot{F} = W - N_6AF - N_7CGFAN - N_8F$$

$$\dot{M} = p_1C + p_2n_1A + p_3N_6AF - L_7M - k_6M$$

$$C = L_5R_1R_2PAN - L_6CGFAN$$

$$C = \frac{L_5R_1R_2PAN}{1 + L_6GFAN}$$

$$\begin{cases} R_2 = R_o - L_1R_1R_2 + L_2R_1R_2PAN \\ R_2 = \dfrac{R_o}{1 + L_1R_1 + L_2R_1PAN} \end{cases}$$

$$\begin{cases} R_1 = S - k_oR_1R_2 - k_1R_1R_2PAN \\ R_1 = \dfrac{S}{1 + k_oR_2 + k_1R_2PAN} \end{cases}$$

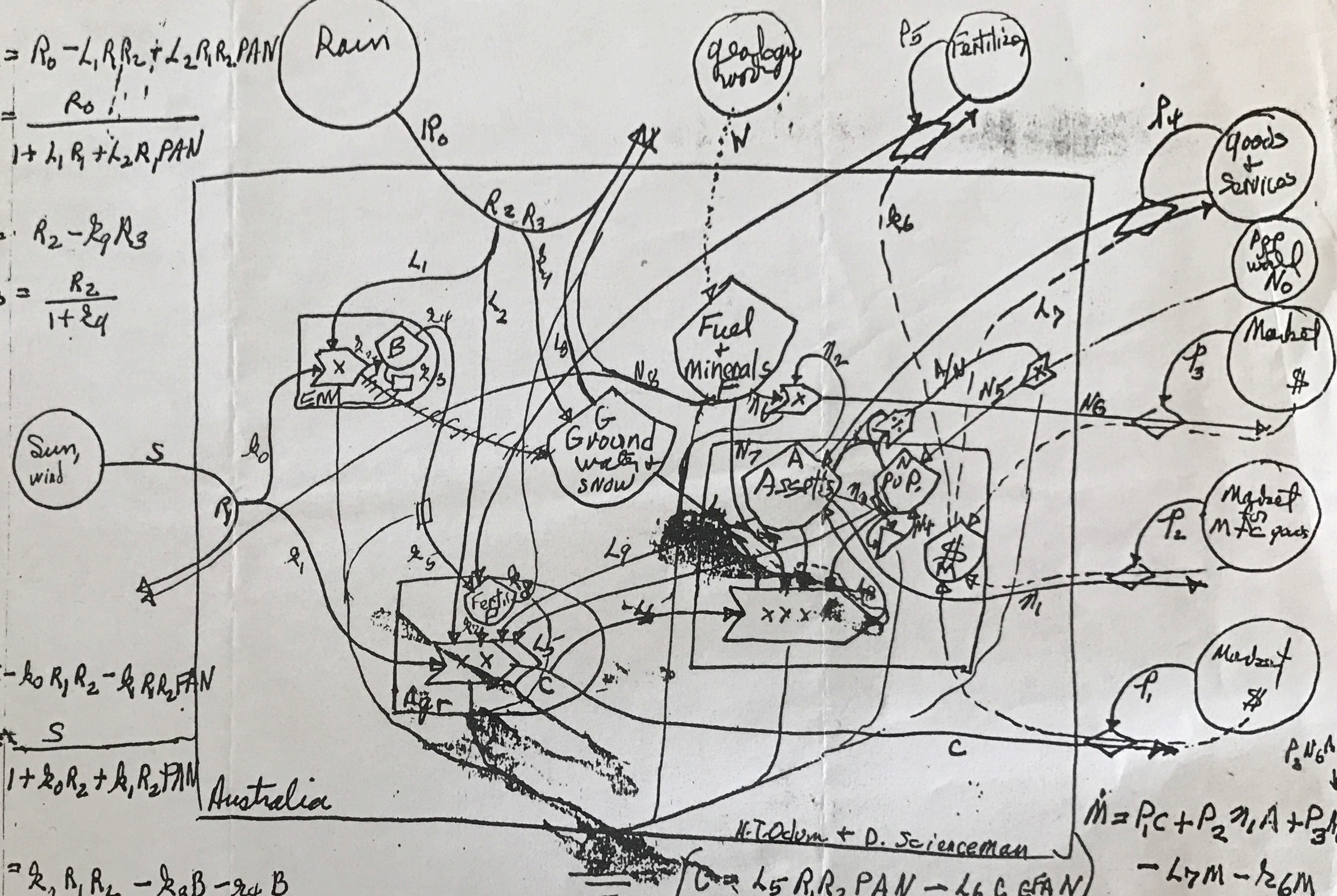
$$\begin{cases} R_3 = R_2 - k_9R_3 \\ R_3 = \dfrac{R_2}{1 + k_9} \end{cases}$$

$$R_2 = R_0 - L_1 R_1 R_2 + L_2 R_1 R_2 PAN$$

$$R_2 = \frac{R_0}{1 + L_1 R_1 + L_2 R_1 PAN}$$

$$R_3 = R_2 - k_9 R_3$$

$$R_3 = \frac{R_2}{1 + k_9}$$



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$$R_1 = S - k_0 R_1 R_2 - k_1 R_1 R_2 FAN$$

$$R_1 = \frac{S}{1 + k_0 R_2 + k_1 R_2 FAN}$$

H.T. Odum + D. Scienceman

$$\dot{M} = P_1 C + P_2 n_1 A + P_3 N_6 AF - L_7 M - k_6 M$$

$$\dot{B} = k_2 R_1 R_2 - k_3 B - k_4 B$$

$$\dot{P} = k_6 B + \frac{k_5 M}{P_5} - k_7 R_1 R_2 PAN - k_8 P$$

$$\dot{G} = k_9 R_3 - L_3 G - L_4 C G FAN$$

$$C = L_5 R_1 R_2 PAN - L_6 C G FAN$$

$$C = \frac{L_5 R_1 R_2 PAN}{1 + L_6 G FAN}$$

$$\dot{A} = \frac{L_7 M}{P_4} + L_8 C G FAN - L_9 R_1 R_2 PAN - n_1 A - n_2 AF - n_3 N$$

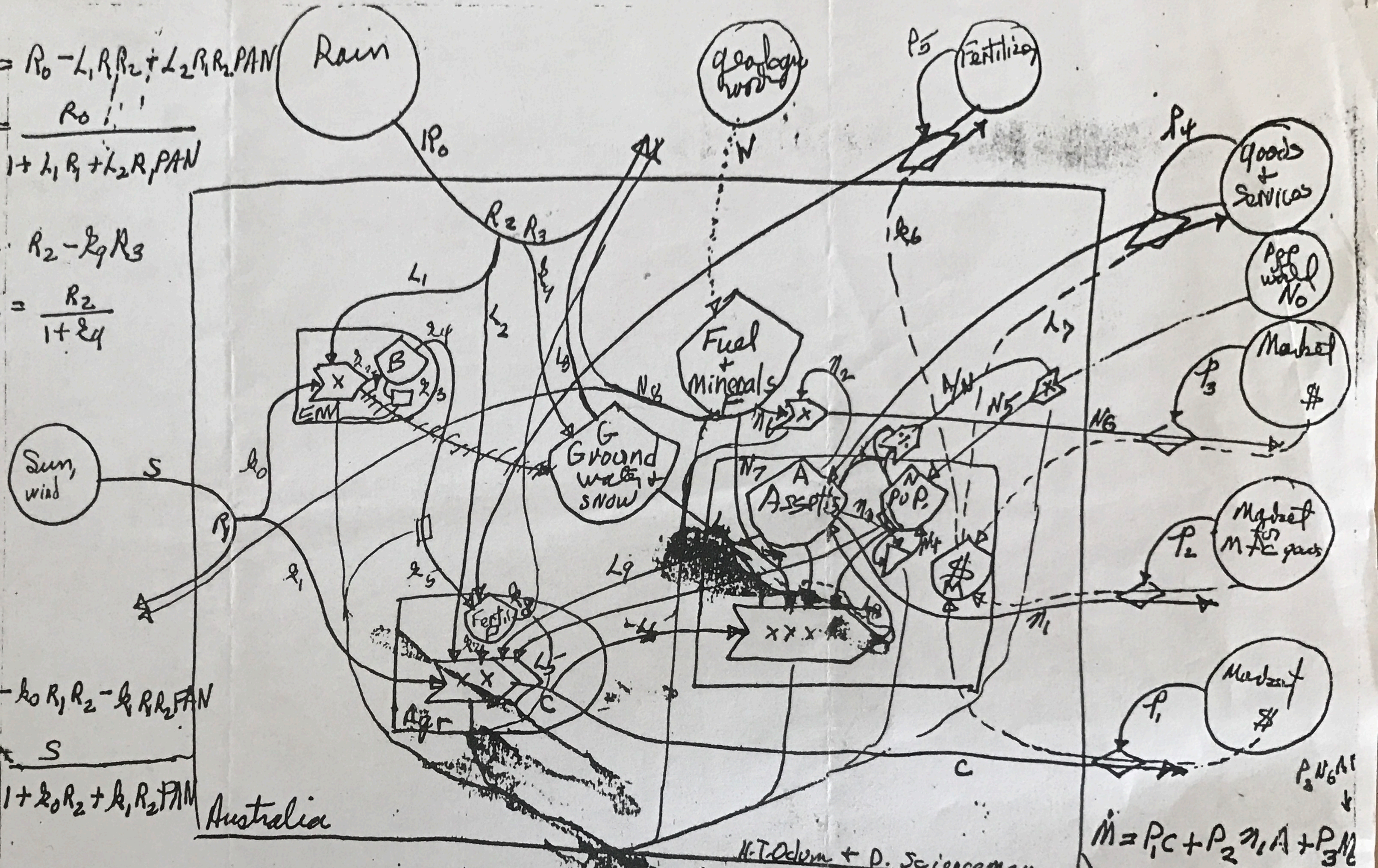
$$\dot{N} = N_4 N + N_5 (A)(N_0) \qquad \dot{F} = W - N_6 AF - N_7 C G FAN - N_8 P$$

$$R_2 = R_0 - L_1 R_1 R_2 + L_2 R_1 R_2 PAN$$

$$R_2 = \frac{R_0}{1 + L_1 R_1 + L_2 R_1 PAN}$$

$$R_3 = R_2 - k_9 R_3$$

$$R_3 = \frac{R_2}{1 + k_9}$$



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$$R_1 = S - k_0 R_1 R_2 - k_1 R_1 R_2 FAN$$

$$R_1 = \frac{S}{1 + k_0 R_2 + k_1 R_2 FAN}$$

$$\dot{B} = k_2 R_1 R_2 - k_3 B - k_4 B$$

$$\dot{P} = k_6 B + \frac{k_5 M}{P_5} - k_7 R_1 R_2 PAN - k_8 P$$

$$\dot{G} = k_9 R_3 - L_3 G - L_4 C\,GFAN$$

$$C = L_5 R_1 R_2 PAN - L_6 C\,GFAN$$

$$C = \frac{L_5 R_1 R_2 PAN}{1 + L_6 GFAN}$$

$$\dot{M} = P_1 C + P_2 n_1 A + P_3 N_6 AF - L_7 M - k_6 M$$

$$\dot{A} = \frac{L_7 M}{P_4} + L_8 CGFAN - L_9 R_1 R_2 PAN - n_1 A - n_2 AF - n_3 N$$

$$\dot{N} = N_4 N + N_5 \left(\frac{A}{N}\right)(N_0) \qquad \dot{F} = W - N_6 AF - N_7 CGFAN - N_8 P$$

1 g/cm^3; g = the acceleration of gravity = 980 cm/s^2; and h = the average

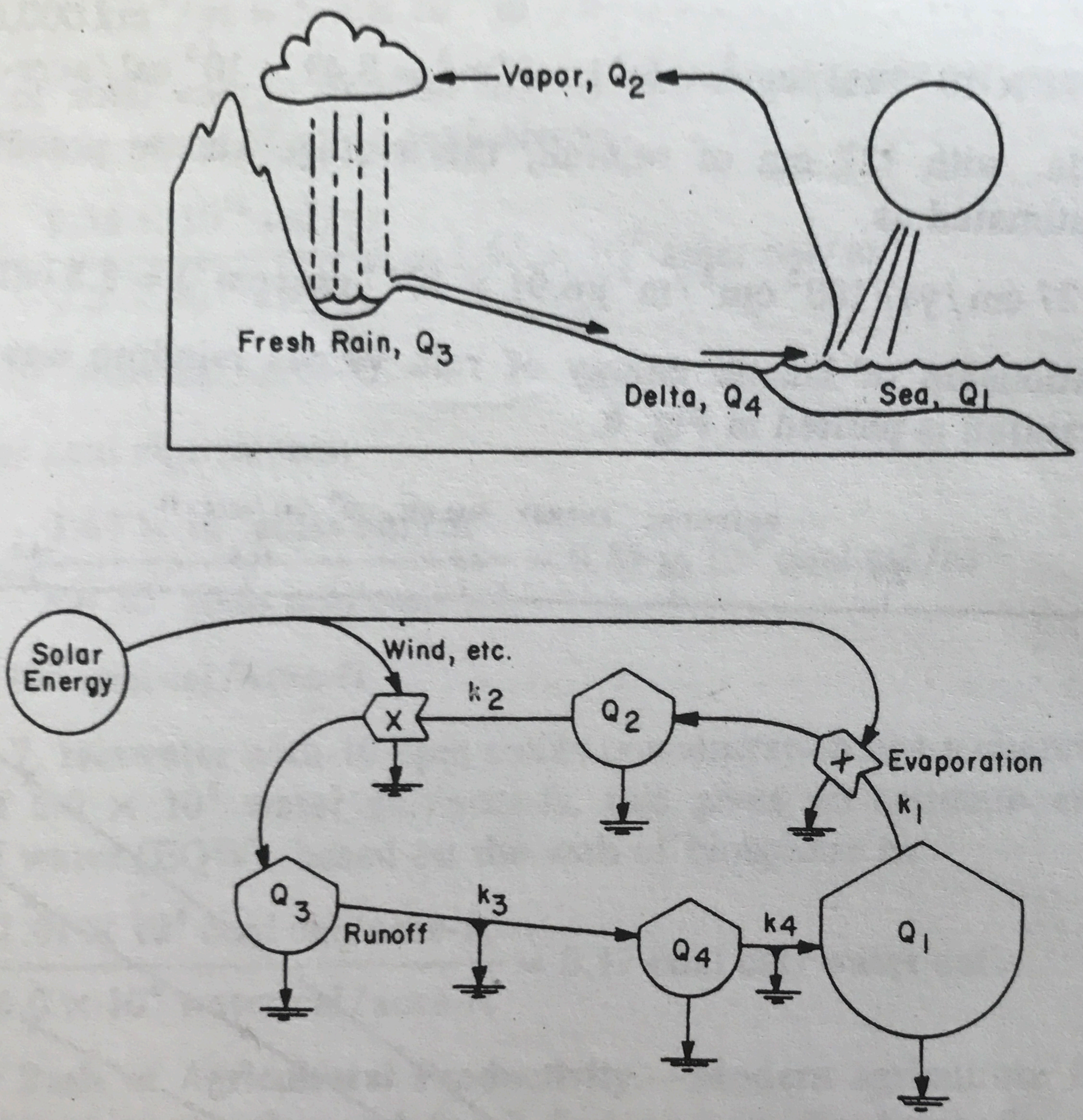

FIG. 4.—Hydrologic Cycle from Energy Flow Perspective

height of land (say in Florida, 10 m above mean sea level). Substituting these values into Eq. 1 gives:

1 g/cm^3; g = the acceleration of gravity = 980 cm/s^2; and h = the average

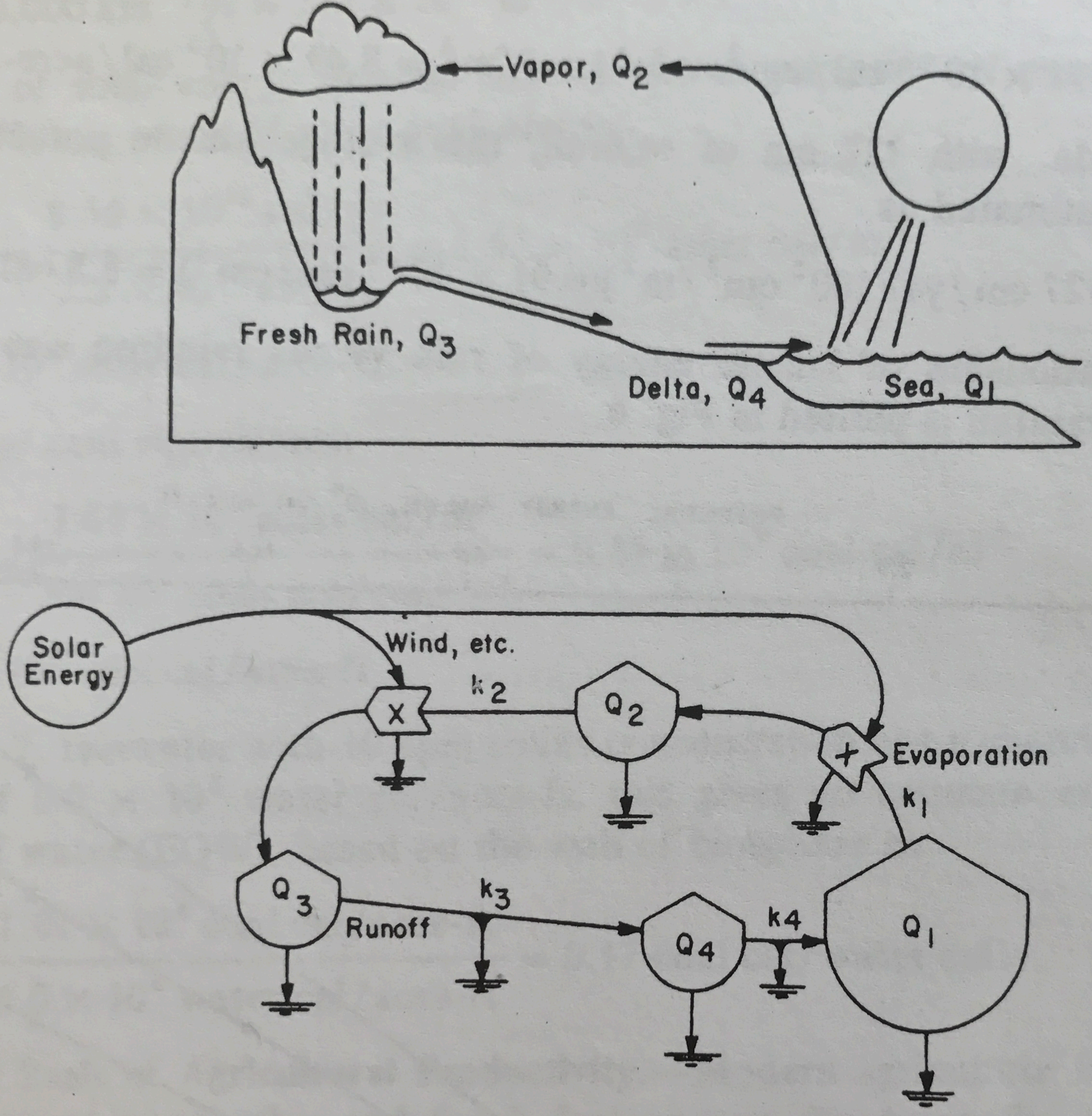

FIG. 4.—Hydrologic Cycle from Energy Flow Perspective

height of land (say in Florida, 10 m above mean sea level). Substituting these

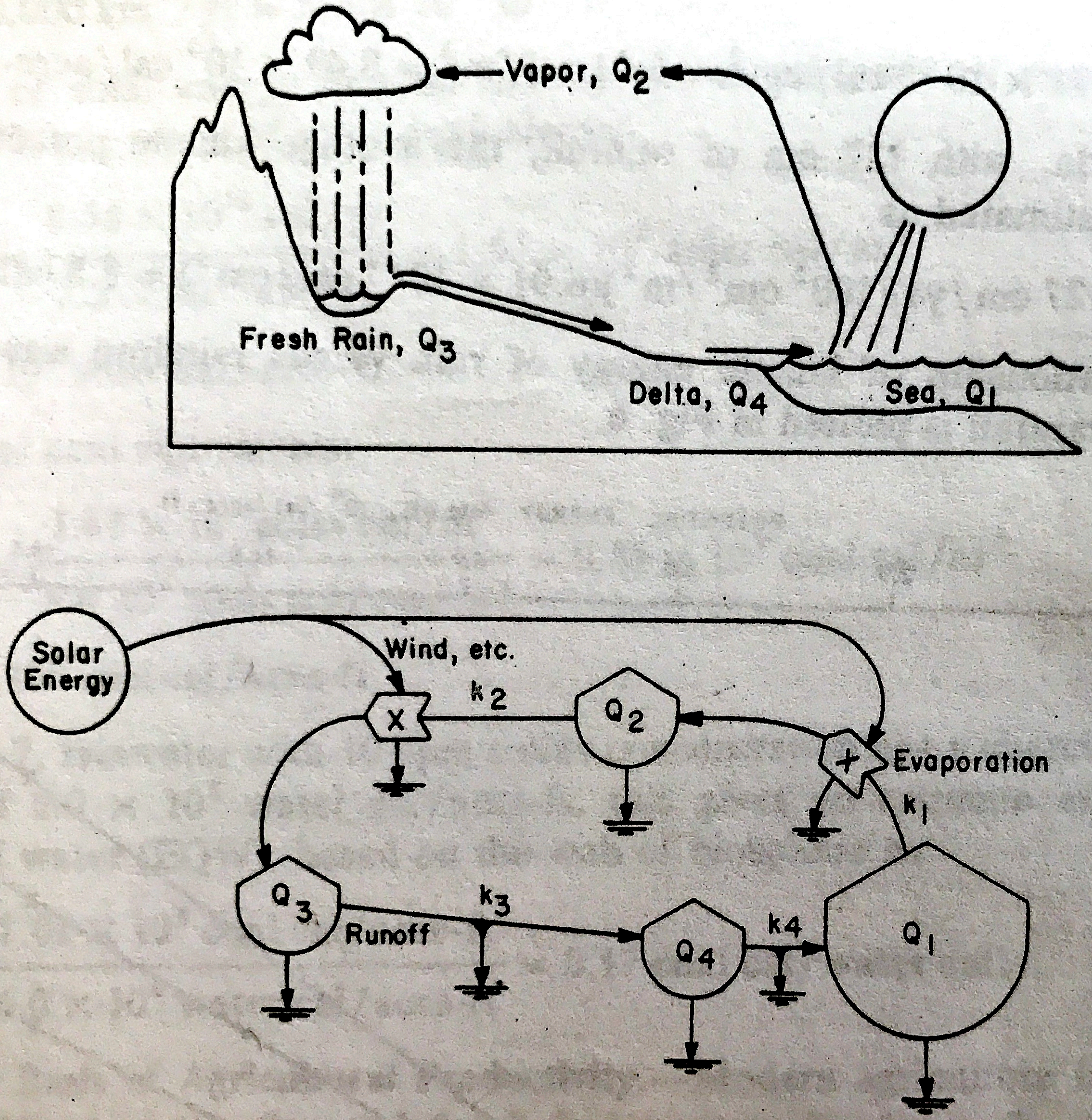

FIG. 4.—Hydrologic Cycle from Energy Flow Perspective

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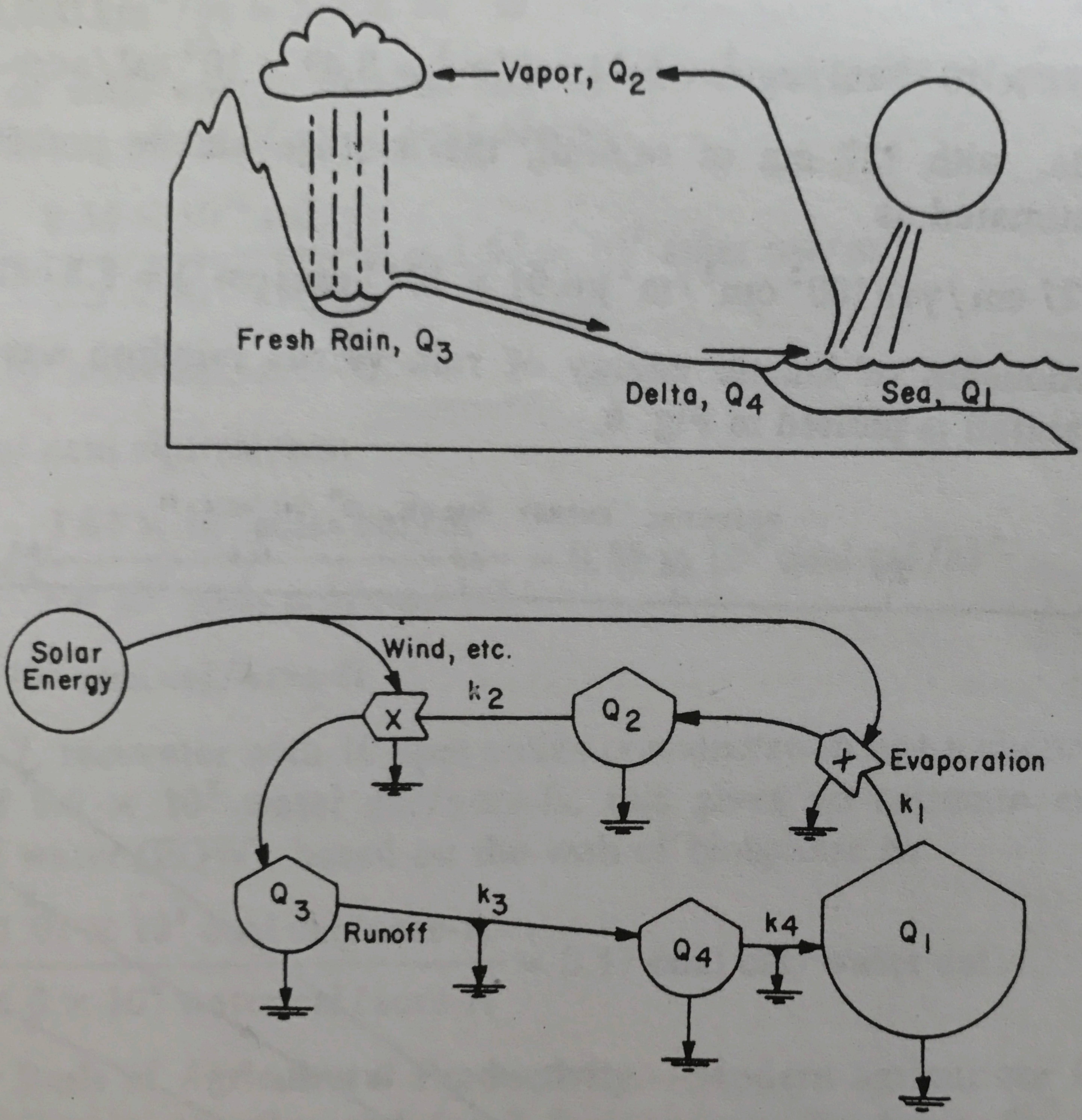

FIG. 4.—Hydrologic Cycle from Energy Flow Perspective

height of land (say in Florida, 10 m above mean sea level). Substituting these

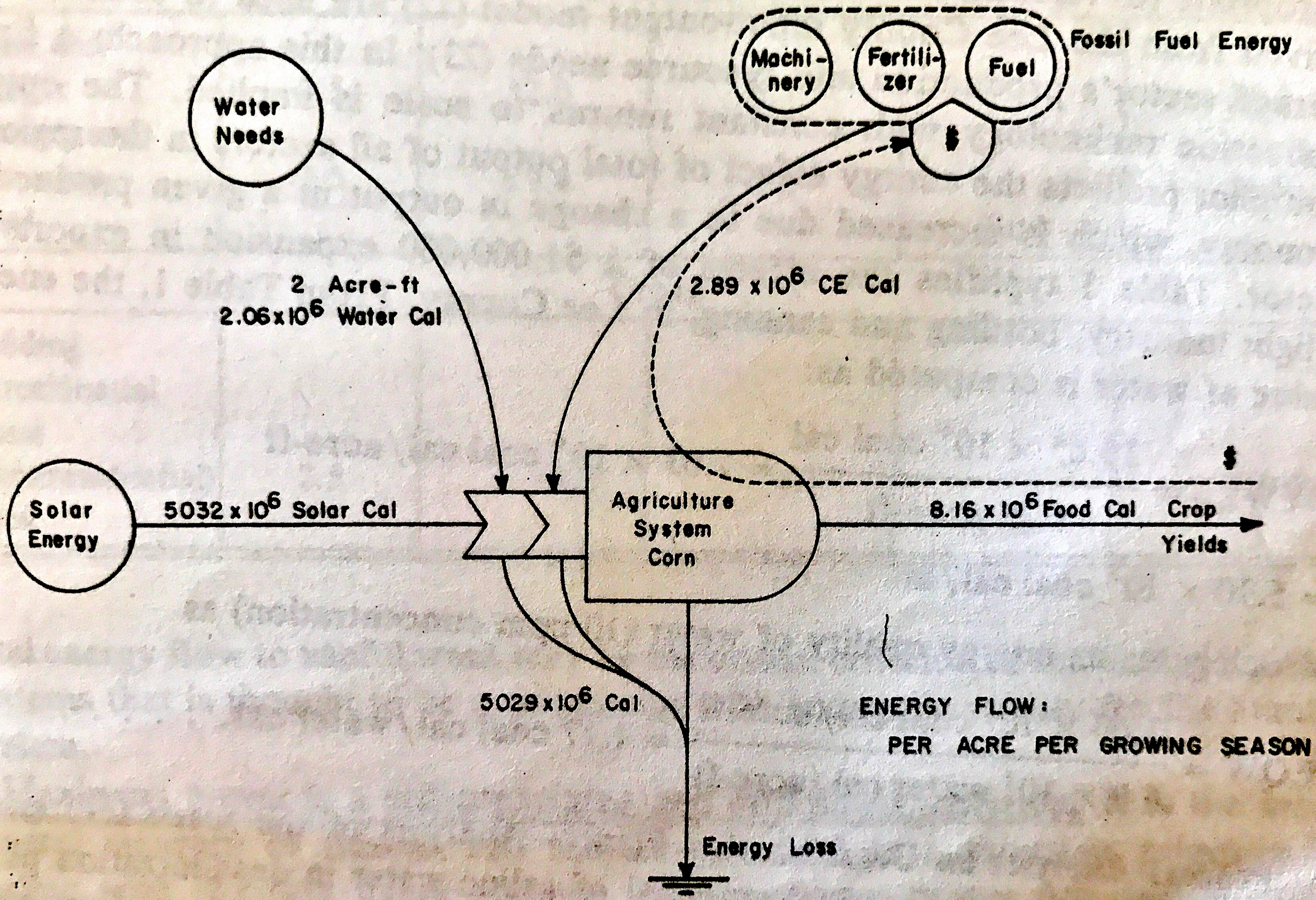

FIG. 8.—Simplified Agricultural Crop Unit Model

is considered a free energy and thus commonly ignored. The first and second

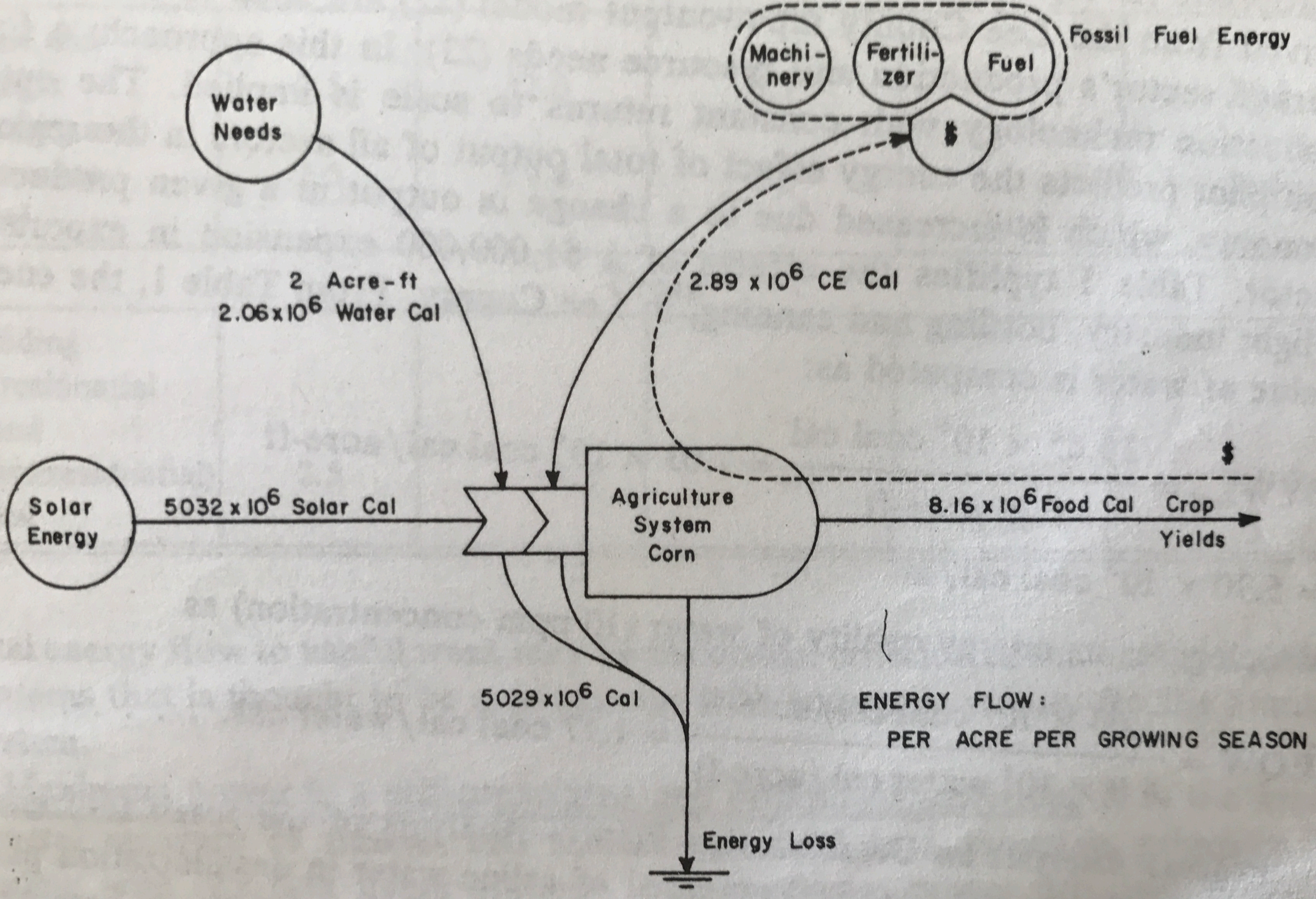

FIG. 8.—Simplified Agricultural Crop Unit Model